

Appl. No. 09/787,819  
Amdt. Dated November 22, 2004  
Reply to Office action of May 20, 2004

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application.

**Listing of Claims:**

1. (Currently amended) A method for surface treatment of metallic workpieces ~~of aluminum and/or alloyed aluminum~~ in which a metallic workpiece (12, 12', 12'') is worked at least in part by at least one roll (16, 16', 16'', 74', 74'', 86', 86'') provided at least in part with an outer profile (22, 22', 76, 76', 78, 78') having the form of annular beads and recesses, comprising the steps of:  
    exposing a treated surface (14, 14', 14'') of said workpiece (12, 12', 12'') to compressive stresses; and  
    exposing zones located beneath said treated surface (14, 14', 14'') of said workpiece (12, 12', 12'') to tensile stresses axially and tangentially through contact with said annular beads;  
    ~~wherein the outer profile (22, 22', 76, 76', 78, 78') of the at least one roll (16, 16', 16'', 74', 74'', 86', 86'') works the workpiece (12, 12', 12'') in a direction that is longitudinal or transverse to a direction of movement of the workpiece (12, 12', 12'')~~ wherein said workpiece is worked by said at least one roll in sequence in opposite directions.
2. (Previously presented) The method as set forth in claim 1, wherein said workpiece (12, 12', 12'') is moved in an axial direction by said at least one roll (16, 16', 16'', 74', 74'', 86', 86'') provided with said annular beads.
3. (Canceled)
4. (Previously presented) The method as set forth in claim 1, wherein said workpiece (12) has a round treated surface (14) and is worked by at least one roll (16, 16', 16'') provided at least in part with an outer profile (22, 22') arranged parallel to said workpiece (12) and which is

rotatable about the longitudinal centerline (18, 18', 18'') thereof as well as about said workpiece (12).

5. (Previously presented) The method as set forth in claim 1, wherein said workpiece (12'') has a treated surface that includes at least one bore (14'') and is worked by at least one roll (16, 16', 16'', 74', 74'', 86', 86'') provided at least in part with an outer profile (22, 22') arranged parallel to said at least one bore (14'') and which is rotatable about said longitudinal centerline (18, 18'') as well as about said at least one bore (14'').

6. (Previously presented) The method as set forth in claim 4, wherein said workpiece (12, 12'') is worked by a roll (16, 16', 16'') provided at least in part with an outer profile (22, 22') and at least two, substantially non-profiled rolls (16'') arranged about said workpiece (12) or in said at least one bore (14'').

7. (Currently amended) The method as set forth in claim 6, wherein said workpiece (12, 12'') is worked by a roll (16'') having an outer profile (22, 22') in the form of annular beads (24) and recesses arranged at a first angle and a second angle to said longitudinal centerline (18, 18', 18'') of said roll (16, 16', 16'', 74', 74'', 86', 86''), wherein ~~the first angle and the second angle have opposite signs~~ either the first angle is positive and the second angle is negative or the first angle is negative and the second angle is positive.

8. (Previously presented) The method as set forth in claim 4, wherein said workpiece (12, 12'') is worked by two rolls (16, 16') each provided at least in part with an outer profile (22, 22') and a substantially non-profiled roll (16'') arranged about said workpiece (12) or in said at least one bore (14'').

9. (Previously presented) The method as set forth in claim 8, wherein said workpiece (12, 12'') is worked by two rolls (16, 16') having an outer profile (22, 22'') in the form of annular beads (24) and recesses (26) arranged at an angle ( $\alpha$ ,  $\alpha'$ ) to said longitudinal centerlines (18, 18') of said rolls (16, 16').

10. (Currently amended) The method as set forth in claim 9, wherein said two rolls (16, 16') are powered in the same direction of rotation when said annular beads (24) and recesses (26) are arranged at a first angle and a second angle to said longitudinal centerlines (18, 18') of said two rolls (16, 16'), wherein ~~the first angle and the second angle have opposite signs~~ either the first angle is positive and the second angle is negative or the first angle is negative and the second angle is positive.

11. (Currently amended) The method as set forth in claim 9, wherein said two rolls (16, 16') are powered in the opposite direction of rotation when said annular beads (24) and recesses (26) are arranged at a first angle and a second angle to said longitudinal centerlines (18, 18') of said two rolls (16, 16'), wherein the first angle and the second angle ~~have the same sign~~ are either both positive or both negative.

12. (Previously presented) The method as set forth in claim 1, wherein the treated surface of said workpiece (12') includes at least one flat surface (14') and is worked by at least one roll (74', 74'', 86', 86'') provided at least in part with an outer profile (76, 76', 78, 78') arranged substantially perpendicular or at an angle  $\beta$  to said workpiece (12') and rotatable about the longitudinal centerline (80) thereof.

13. (Previously presented) The method as set forth in claim 12, wherein said workpiece (12') is worked by at least one roll (74', 74'') provided at least in part with an outer profile (76, 76', 78, 78') and is worked or supported by at least one further roll (86', 86'') provided at least in part with

an outer profile (76, 76', 78, 78') or a non-profiled roll (86, 86'') or similar supporting means located spaced away and opposite said at least one roll (74', 74'').

14. (Previously presented) The method as set forth in claim 13, wherein said at least one flat surface (14') to be treated of said workpiece (12') is worked by said at least one roll (74', 74'', 86', 86'') including an outer profile (76, 76', 78, 78') in the form of annular beads (24) and recesses (26).

15. (Currently amended) The method as set forth in claim 14, wherein said at least one flat surface (14') of said workpiece (12') to be treated is worked by several rolls (74', 74'', 86', 86'') having an outer profile (76, 76', 78, 78') in the form of annular beads (94) and recesses (96), whereby said annular beads (94) and recesses (96) of adjoining rolls (74', 74'', 86', 86'') differ from each other in their configuration and arrangement ~~and~~ or each of said adjoining rolls (74', 74'', 86', 86'') is powered in a different direction of rotation.

16. (Currently amended) The method as set forth in claim ~~15~~ 14, wherein said at least one flat surface (14') of said workpiece (12') to be treated is worked by rolls (74'', 86'') having an outer profile (78, 78') in the form of annular beads (24) and recesses (26) arranged at an angle ( $\alpha$ ,  $\alpha'$ ) to said longitudinal centerlines (80) of said rolls (74'', 86''), whereby said rolls (74'', 86'') are powered in the same direction of rotation for a substantially opposite lead position of said beads (24) and recesses (26) or in the opposite direction of rotation for a substantially same lead position of said beads (24) and recesses (26).

17. (Previously presented) The method as set forth in claim 15, wherein said at least one flat surface (14') of said workpiece (12') to be treated is worked by rolls (74', 86') having an outer profile (76, 76') in the form of annular beads (94) and recesses (96) arranged perpendicular to their longitudinal centerlines (80), said rolls being axially staggered relative to each other.

18. (Previously presented) The method as set forth in claim 1, wherein said workpiece (12, 12', 12'') or said treated surface (14, 14', 14'') is coated with a covering of metal, a metal alloy, a paint, plastics, is anodized, galvanized or pickled.

19. (Withdrawn) A device for surface treatment of workpieces (12) of aluminum and/or alloyed aluminum having a round surface (14), which is worked at least in part by at least one roll (16, 16', 16'') provided at least in part with an outer profile (22, 22') having the form of annular beads and recesses at an angle  $\alpha$  or  $\alpha'$  to the longitudinal centerline of the roll by exposing the treated surface (14) of said workpiece (12) to compressive stresses; and exposing zones located beneath said treated surface (14) of said workpiece (12) to tensile stresses axially and tangentially, comprising:

three rolls (16, 16', 16'', 16''') arranged parallel to and about said workpiece (12) provided at least in part with an outer profile (22, 22') configured in the form of annular beads (24) and recesses (26) arranged at an angle ( $\alpha$ ,  $\alpha'$ ) to said longitudinal centerline (18, 18', 18'') of said roll (16, 16', 16'') working said surface (14) of said workpiece (12) and each rotatable about their longitudinal centerlines (18, 18', 18'', 18''') as well as in combination about said workpiece (12).

20. (Withdrawn) The device for surface treatment of workpieces (12'') of aluminum and/or alloyed aluminum having at least one bore (14''), which is worked at least in part by at least one roll (16, 16', 16'', 16''') provided at least in part with an outer profile (22, 22') having the form of annular beads and recesses at an angle  $\alpha$  or  $\alpha'$  to the longitudinal centerline of the roll by exposing the treated surface (14, 14', 14'') of said workpiece (12'') to compressive stresses; and exposing zones located beneath said treated surface (14'') of said workpiece (12'') to tensile stresses axially and tangentially, comprising:

at least two rolls (16, 16', 16'', 16''') provided at least in part with an outer profile (22, 22') configured in the form of annular beads (24) and recesses (26) arranged at an angle ( $\alpha$ ,  $\alpha'$ ) to said longitudinal centerline (18, 18', 18'') of said roll (16, 16', 16'') working said surface (14) of said

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workpiece (12") and each rotatable about their longitudinal centerlines (18, 18', 18", 18''') as well as in combination about said workpiece (12") working said bore (14") and each rotatable individually about their longitudinal centerlines (18, 18', 18", 18''') as well as in combination in said bore (14").

21. (Canceled)

22. (Withdrawn) The device as set forth in claim 20, wherein one roll (16") is configured non-profiled.

23. (Withdrawn) The device as set forth in claim 20, wherein said at least two rolls (16, 16', 16''') are provided at least in part with an outer profile (22, 22') working said workpiece (12, 12") in sequence in opposite directions.

24. (Withdrawn) The device as set forth in claim 23, wherein said one roll (16''') is provided with an outer profile (22, 22') in the form of annular beads (24) and recesses arranged at an angle ( $\alpha$ ,  $\alpha'$ ) to said longitudinal centerline (18''') of said roll (16''') in a lead position substantially opposing each other.

25. (Withdrawn) The device as set forth in claim 23, wherein two adjoining rolls (16, 16') having an outer profile (22, 22') are drivable in the same direction of rotation for substantially an opposed lead position of said beads (24) and recesses (26) and in the opposite direction of rotation for substantially the same lead position of said beads (24) and recesses (26).

26. (Withdrawn) The device as set forth in claim 20, wherein said at least one roll (16, 16', 16''') is provided with non-profiled ends (30, 32).

27. (Withdrawn) The device as set forth in claim 26, wherein said non-profiled end (30) of said at least one roll (16, 16', 16'') incoming in said direction of movement of said workpiece (12, 12'') comprises a slightly smaller outer diameter.

28. (Withdrawn) The device as set forth in claim 26, wherein said non-profiled end (32) of said at least one roll (16, 16', 16'') outgoing in said direction of movement of said workpiece (12, 12'') has a slightly larger outer diameter.

29. (Withdrawn) The device as set forth in claim 19, wherein said rolls (16, 16', 16'', 16''') are mounted by a drive means (34) for rotating each of said rolls (16, 16', 16'', 16''') individually about their longitudinal centerlines (18, 18', 18'', 18''') and by a drive head for rotating said rolls (16, 16', 16'', 16''') in combination about said workpiece (12) or in said at least one bore (14'') of said workpiece (12'').

30. (Withdrawn) The device as set forth in claim 29, wherein each of said rolls (16, 16', 16'', 16''') is non-rotatably mounted by said drive means (34) by one end (30), via a section (38) and a correspondingly shaped recess (40) of said drive means (34), and is rotatably mounted by said drive head (36) or similar drive arrangement by one end (32).

31. (Withdrawn) The device as set forth in claim 29, wherein said drive means (34) and/or said drive head (36) is/are controllable hydraulically or pneumatically.

32. (Withdrawn) The device as set forth in claim 29, wherein said drive means (34) comprises drive motors (46) each assigned to one of said rolls (16, 16', 16'').

33. (Withdrawn) The device as set forth in claim 29, wherein said drive head (36) or similar drive arrangement is rotatable with a worm drive (48) powered more particularly via a separate drive motor (50).

34. (Withdrawn) The device as set forth in claim 29, wherein said drive means (34) and said drive head (36) are configured movable relative to each other.

35. (Withdrawn) The device as set forth in claim 34, wherein said drive means (34) is longitudinally shiftable via a guide means (52) and a mechanically, electrically, hydraulically or pneumatically actuatable drive element (54).

36. (Withdrawn) The device as set forth in claim 29, wherein said drive means (34) and/or said drive head (36) is/are provided with a centering means (58) for said workpiece (12).

37. (Withdrawn) A device for surface treatment of workpieces (12) of aluminum and/or alloyed aluminum having at least one flat surface (14'), which is worked at least in part by at least one roll (74', 74'', 86', 86'') provided at least in part with an outer profile (76, 76', 78, 78') having the form of annular beads and recesses by exposing the treated surface (14') of said workpiece (12') to compressive stresses; and exposing zones located beneath said treated surface (14') of said workpiece (12') to tensile stresses axially and tangentially, comprising:

at least one roll (74', 74'', 86', 86'') arranged substantially perpendicular or at an angle  $\beta$  to the longitudinal direction (arrow 28) of said workpiece (12') which is provided with an outer profile (76, 76', 78, 78') configured in the form of annular beads (94) and recesses (96) of said at least one roll (74'') arranged at an angle ( $\alpha$ ,  $\alpha'$ ) to the longitudinal centerline (80) thereof or annular beads (94) and recesses (96) arranged perpendicular working said surface (14') of said workpiece (12') at least in part and which is rotatable about the longitudinal centerline (80) thereof.

38. (Withdrawn) The device as set forth in claim 37, wherein said at least one roll (74', 74'') provided with an outer profile (76, 76', 78, 78') at least in part is assigned at least one further roll (86', 86'') provided at least in part with an outer profile (76, 76', 78, 78') or non-profiled roll (86', 86'') supporting means opposite.



39. (Withdrawn) The device as set forth in claim 37, wherein said at least one roll (74', 74", 86', 86") provided with an outer profile (76, 78) at least in part is followed by an additional roll (74', 74", 86', 86") provided likewise at least in part with an outer profile (76', 78') to work said surface (14') of said workpiece (12') in sequence in the opposite direction.

40. (Withdrawn) The device as set forth in claim 39, wherein said two rolls (74", 86") following each other comprise annular beads (94) and recesses (96) arranged at an angle ( $\alpha$ ,  $\alpha'$ ) to the longitudinal centerlines (80) thereof, said two rolls (74", 86") being powered in the same direction of rotation when said annular beads (94) and recesses (96) comprise a lead position substantially opposing or in the opposite direction of rotation when said annular beads (94) and recesses (96) comprise a lead position substantially the same.

41. (Withdrawn) The device as set forth in claim 39, wherein said two rolls (74', 86') following each other comprise annular beads (94) and recesses (96) arranged perpendicular to the longitudinal centerlines (80) thereof, said two rolls (74', 86') and/or said annular beads (94) and recesses (96) being axially staggered relative to each other.

42. (Withdrawn) The device as set forth in claim 37, wherein at least one non-profiled roll (74, 74"', 86', 86'") is provided upstream and/or downstream of said at least one roll (74', 74", 86', 86") provided at least in part with an outer profile (76, 76', 78, 78') working said surface (14') of said workpiece (12') in the direction of movement of said workpiece (12').

43. (Withdrawn) The device as set forth in claim 42, wherein said at least one upstream non-profiled roll (74', 74"', 86', 86'") comprises a slightly smaller outer diameter.

44. (Withdrawn) The device as set forth in claim 42, wherein said at least one non-profiled downstream roll (74', 74"', 86', 86'") comprises a slightly larger outer diameter.

45. (Withdrawn) The device as set forth in claim 37, wherein said annular beads (24, 94) protrude beyond the outer diameter of said at least one roll (16, 16', 74', 74'', 86', 86'').
46. (Withdrawn) The device as set forth in claim 37, wherein said at least one roll (74', 74'') is mounted in a mounting means (72) movable relative to supporting means (84) supporting said workpiece (12').
47. (Withdrawn) The device as set forth in claim 46, wherein said mounting means (72) is adjustable relative to said supporting means (84) via a guide means (88) and a mechanically, electrically, hydraulically or pneumatically actuatable drive element (90), or a pressure cylinder.
48. (Withdrawn) The device as set forth in claim 46, wherein said supporting means (84) comprises said at least one further roll (86', 86'') provided at least in part with an outer profile (78, 78') or said non-profiled roll (86, 86''').
49. (Withdrawn) The device as set forth in claim 46, wherein said mounting means (72) and/or said supporting means (84) is/are expediently hydraulically or pneumatically controllable.
50. (Withdrawn) The device as set forth in claim 46, wherein said at least one further roll (74', 74'', 86', 86'') provided with an outer profile (76, 76', 78, 78') at least in part and/or non-profiled is assigned in each case a separate drive motor (92).
51. (Withdrawn) The device as set forth in claim 37, wherein said rolls (16, 16', 16''', 74, 74', 74'', 74''', 86, 86'', 86''') are configured multi-part, being composed of a roll (60) as well as a sleeve (64) non-rotatively connected to said shaft (6) together with said outer profile (22, 22', 76, 76', 78, 78') provided at least in part, said smooth incoming end (30) and said smooth outgoing end (32) or with a smooth surface throughout.

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52. (Withdrawn) The device as set forth in claim 37, wherein said rolls (16, 16', 16'', 74, 74', 74'', 74'', 86, 86', 86'', 86'') are coolable by an internal cooling system and/or an external cooling bath.

53. (Currently amended) A method as set forth in claim 1, for surface treatment of workpieces (12, 12', 12'') of base metals such as aluminum, lead, chromium, iron, cobalt, nickel, copper, manganese, molybdenum, silicon, tungsten, tin, zinc or alloys thereof including brass, steel, ~~and/or~~ aluminum ~~and/or~~ alloyed aluminum including  $\text{AlMg}_{4.5}\text{Mn}$ ,  $\text{AlMgSi}_{0.5}$ ,  $\text{AlMgSi}$ ,  $\text{AlMg}_5$ ,  $\text{AlZn}_{4.5}\text{Mg}$ ,  $\text{AlCuMg}$ ,  $\text{AlCuMg}_2$ ,  $\text{AlZnMgCu}_{0.5}$ ,  $\text{AlZnMgCu}_{1.5}$ ,  $\text{AlCuMgPb}$  or of noble metals including gold, palladium, platinum, silver or alloys thereof, or of combinations of base and noble metals.

54. (Currently amended) The method as set forth in claim 1, for producing elongated sections (12, 12') of solid metal, selected from wires, rods and strip ~~and/or~~ tubular material for headrest brackets in automobiles.

55. (Currently amended) The method as set forth in claim 1, for producing coiled, or hardened ~~and/or~~ coated workpieces for coiled springs.

56. (Currently amended) The method as set forth in claim 1, wherein the surface of the workpiece that is treated is an interior surface of a bore, a through-hole ~~and/or~~ a blind hole in an automotive engine.

57. (Previously presented) The method as set forth in claim 1, for producing elongated sections (12') of solid metal including at least one flat surface (14') for headrest brackets in automobiles.

58. (Currently amended) The method as set forth in claim 1, wherein said metal; includes base metals selected from aluminum, lead, chromium, iron, cobalt, nickel, copper, manganese, molybdenum, silicon, tungsten, tin, zinc or alloys thereof including brass, steel, ~~and/or~~ aluminum ~~and/or~~ alloyed aluminum selected from  $\text{AlMg}_{4.5}\text{Mn}$ ,  $\text{AlMgSi}_{0.5}$ ,  $\text{AlMgSi}$ ,  $\text{AlMg}_5$ ,  $\text{AlZn}_{4.5}\text{Mg}$ ,  $\text{AlCuMg}$ ,  $\text{AlCuMg}_2$ ,  $\text{AlZnMgCu}_{0.5}$ ,  $\text{AlZnMgCu}_{1.5}$ ,  $\text{AlCuMgPb}$  or of noble metals selected from gold, palladium, platinum, silver or alloys thereof, or of combinations of base and noble metals.

59. (Withdrawn) The device as set forth in claim 20, wherein elongated sections (12) of solid metal are produced, selected from wires, rods and strip and/or tubular material, for headrest brackets in automobiles.

60. (Withdrawn) The device as set forth in claim 19, wherein coiled workpieces (12) are produced, for coiled springs.

61. (Withdrawn) The device as set forth in claim 19, wherein bores (14") through-holes and/or blind holes for automotive engines are produced.

62. (Withdrawn) The device as set forth in claim 37, wherein elongated sections (12') of solid metal including at least one flat surface (14') are produced for headrest brackets in automobiles.

63. (Previously presented) The method as set forth in claim 1, wherein the workpiece is worked by two rolls.

64. (New) The method according to claim 1, wherein the workpieces are aluminum or alloyed aluminum.